

CLAIMS

WE CLAIM:

5 1. An air outflow valve, comprising:
 a valve body;
 a valve disk movably mounted on the valve body and moveable through a
 plurality of positions between a closed position and an open position;
 at least one control arm coupled to the valve disk;
10 at least one biasing element coupled between each control arm and the
 valve body for biasing the valve toward the closed position;
 a control diaphragm mounted within the valve body;
 at least one retainer coupled to the control diaphragm, the retainer having a
 body with an opening and an internal surface defining a cavity, the cavity
15 extending from the opening a predetermined distance within the retainer; and
 at least one cable having a first end and a second end, the first end coupled
 to the control arm and the second end inserted through the opening and slidably
 located in the retainer cavity, the second end moveable within the retainer cavity
 between the opening and a position along the predetermined distance of the
20 cavity,
 wherein the opening of the retainer is configured to retain the second end
 therein.

25 2. The valve of Claim 1, further comprising:
 at least one pulley assembly mounted within the valve body, the pulley
 assembly including a rotationally mounted pulley positioned to contact at least a
 portion of the cable when the cable is in tension.

30 3. The valve of Claim 2, wherein the pulley assembly comprises:
 a pulley bracket having a base coupled to the valve body;

at least two support arms extending from the base at a predetermined angle relative to the base, each support arm having a first end coupled to the base and a second end distal to the first end;

5 a pulley rotationally mounted between the support arms proximate the second ends thereof; and

a roll pin mounted between the support arms proximate the first ends thereof.

10 4. The valve of Claim 3, wherein the pulley assembly further comprises a sleeve bearing on which the pulley is rotationally mounted.

5. The valve of Claim 3, wherein base of the pulley assembly includes at least one cutout on a portion thereof.

15 6. The valve of Claim 1, wherein the valve disk comprises a butterfly plate.

20 7. The valve of Claim 6, further comprising:
a shaft rotationally mounted within the valve body, wherein the valve plate is coupled to the shaft

25 8. The valve of Claim 1, wherein:
the valve body includes at least a first chamber and a second chamber; and
the control diaphragm isolates the first chamber from the second chamber.

9. The valve of Claim 8, further comprising:
a control vacuum pressure port coupled to the first chamber for receiving a control vacuum having a modulated magnitude,

30 wherein the position of the control diaphragm is modulated based on the modulated control vacuum magnitude.

10. The valve of Claim 1, wherein each of the cables has a retaining ball coupled to the first end, and wherein each of the control arms comprises:

a main body portion;

5 at least two arms extending from the main body portion substantially parallel with one another and spaced apart from one another to form a slot there between, each arm including an indentation collocated with the indentation in the other arm to form a retaining hole for receiving the retaining ball therein,

10 wherein the retaining hole is dimensioned so as to allow the retaining ball to move within the retaining hole.

11. The valve of Claim 10, wherein each of the control arms further comprises a roll pin coupled between each of the two arms, and wherein the biasing element is coupled to the roll pin.

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12. The valve of Claim 10, wherein edges of the slot are relatively smooth.

13. A cable assembly for coupling between the diaphragm and a control arm of an air outflow valve, the cable assembly comprising:

a retainer having a body with an opening in a first end thereof and an internal surface defining a cavity, the cavity extending from the opening a predetermined distance within the retainer; and

a cable having a first end and a second end, the first end adapted for coupling to the control arm and the second end inserted through the opening and slidably retained within the retainer cavity, the second end moveable within the retainer cavity between the opening and a position along the predetermined distance of the cavity,

wherein the opening of the retainer is configured to retain the second end therein.

14. The cable assembly of Claim 13, further comprising:

a first retaining ball coupled to the first end of the cable; and

a second retaining ball coupled to the second end of the cable and operable to prevent the second end from being removed from the retainer opening.

15. The cable assembly of Claim 13, further comprising:

threads on at least a portion of an external surface of the retainer.

16. The cable assembly of Claim 15, further comprising:

at least one indentation in a second end of the retainer for receiving a tool therein.

17. The cable assembly of Claim 13, wherein the opening of the retainer is not as wide as the width of the cavity.

18. A method of modifying an air outflow valve having a valve body, a valve disk movably mounted within the valve body, a control arm coupled to the valve disk, a biasing element coupled between the control arm and the valve body, a control diaphragm mounted within the valve body, at least one cable assembly having a first end coupled to the control arm and a second end coupled to the control diaphragm, the method comprising:

disassembling at least a portion of the valve body;

replacing each of the cable assemblies with a replacement cable assembly, each replacement cable assembly including:

a retainer having a body with an opening in a first end thereof and an internal surface defining a cavity, the cavity extending from the opening a predetermined distance within the retainer; and

a cable having a first end and a second end, the first end adapted for coupling to the control arm and the second end inserted through the opening and slidably retained within the retainer cavity, the second end moveable within the retainer cavity between the opening and a position along the predetermined distance of the cavity, wherein the opening of the retainer is configured to retain the second end therein.

and

reassembling the disassembled portions of the valve body.

19. The method of Claim 18, wherein the valve further comprises at least one pulley assembly, and wherein the method further comprises:

replacing each of the pulley assemblies with a replacement pulley assembly, each replacement pulley assembly including:

a pulley bracket having a base coupled to the valve body;

at least two support arms extending from the base at a predetermined angle relative to the base, each support arm having a first end coupled to the base and a second end distal to the first end;

a pulley rotationally mounted between the support arms proximate the second ends thereof;

a roll pin mounted between the support arms proximate the first ends thereof.

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20. The method of Claim 18, wherein the pulley assembly further comprises a sleeve bearing on which the pulley is rotationally mounted.

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21. The method of Claim 18, wherein base of the pulley assembly includes at least one cutout on a portion thereof.

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22. The method of Claim 18, further comprising:
replacing each of the control arms with a replacement control arm, each replacement pulley assembly including:

a main body portion;

at least two arms extending from the main body portion substantially parallel with one another and spaced apart from one another to form a slot there between, each arm including an indentation collocated with the indentation in the other arm to form a retaining hole for receiving the retaining ball therein,

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wherein the retaining hole is dimensioned so as to allow the retaining ball to move within the retaining hole.

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23. The method of Claim 22, wherein each of the control arms further comprises a roll pin coupled between each of the two arms, and wherein the biasing element is coupled to the roll pin.

24. The method of Claim 22, wherein edges of the slot are relatively smooth.

25. A kit for modifying an air outflow valve having a valve body, a valve disk movably mounted within the valve body and moveable through a plurality of positions between a closed position and an open position, and at least one control arm coupled to the valve disk, the kit comprising:

- 5 at least one cable assembly, wherein each cable assembly comprises:
- a retainer having a body with an opening in a first end thereof and an internal surface defining a cavity, the cavity extending from the opening a predetermined distance within the retainer; and
 - 10 a cable having a first end and a second end, the first end adapted for coupling to the control arm and the second end inserted through the opening and slidably retained within the retainer cavity, the second end moveable within the retainer cavity between the opening and a position along the predetermined distance of the cavity,
 - 15 wherein the opening of the retainer is configured to retain the second end therein.

26. The kit of Claim 25, wherein each cable assembly further comprises:

- 20 a first retaining ball coupled to the first end of the cable; and
- a second retaining ball coupled to the second end of the cable and operable to prevent the second end from being removed from the retainer opening.

27. The kit of Claim 25, wherein each cable assembly further includes threads on at least a portion of an external surface of the retainer.

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28. The kit of Claim 25, wherein each cable assembly further comprises interleaved metallic strands.

29. The kit of Claim 25, further comprising:

at least one pulley assembly adapted for mounting within the valve body, the pulley assembly including a rotationally mounted pulley positioned to be in physical contact with at least a portion of the cable when the cable is in tension.

- 5 30. The kit of Claim 29, wherein the pulley assembly comprises:
a pulley bracket having base coupled to the valve body;
at least two support arms extending from the base at a predetermined angle
relative to the base, each support arm having a first end coupled to the base and a
second end distal to the first end;
10 a pulley rotationally mounted between the support arms proximate the
second ends thereof; and
a roll pin mounted between the support arms proximate the first ends
thereof.

- 15 31. The kit of Claim 30, wherein the pulley assembly further comprises
a sleeve bearing on which the pulley is rotationally mounted.

- 20 32. The kit of Claim 30, wherein base of the pulley assembly includes
at least one cutout on a portion thereof.

- 25 33. The kit of Claim 25, further comprising:
at least one control arm including:
a main body portion;
at least two arms extending from the main body portion
substantially parallel with one another and spaced apart from one another
to form a slot there between, each arm including an indentation collocated
with the indentation in the other arm to form a retaining hole for receiving
the retaining ball therein,
30 wherein the retaining hole is dimensioned so as to allow the
retaining ball to move within the retaining hole.

34. The kit of Claim 33, wherein each of the control arms further comprises a roll pin coupled between each of the two arms, and wherein the biasing element is coupled to the roll pin.

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35. The kit of Claim 33, wherein edges of the slot are relatively smooth.

